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a book zoologist. Work in the shop (which we hope he will undertake) will correct his views and give him a place among his friends, American zoologists. In the meantime let him look up the orthography of the words carnivorous and herbivorous. — E. D. C.

BOTANY.

CULTIVATION OF CALIFORNIA ROOTS AND BULBS. — In a climate like ours, clearly discriminated by a wet and long dry season, we find these bulbs located say about six to ten inches deep; the vital fibres, or true roots, shoot downwards ten inches to a foot below this point, in search of food and moisture: thus radiating from the leading germinal end of mostly oblong scaly bulbs — the respectively dormant fibres that have “closed in” serving as stays, etc. Is it not evident, then, that such bulbs require a flower pot at least eighteen inches deep? Hence, ordinary pots must be *utterly useless*, cramping the plant, or inadequate to meet its primary natural indications. Let any one take an improvised five-gallon kerosene or alcohol tin can, or the like, which is good enough, not to say the best, cut out one end and nail narrow slats around the upper margin to add symmetry, avoid unsightly dents, and for convenience in handling; and if one slat is dressed, paint the name, to avoid annoyance of displayed labels; paint rudely inside and out, to preserve; punch say at least three large holes in the bottom; plant, as in nature, in any good soil well composted, and set your can, keg or crock, *in a shallow pan of water*. You will soon have the pleasure of seeing a stout stem, of the size of your thumb, rising up and “rejoicing as a strong man to run a race,” and flowering gorgeously. Let it generally be observed here, once for all, that in California *underground* irrigation, or water supply from beneath, is the requisite rule or law to be observed, especially in their advanced stage of growth. Many California plants are not only injured but killed outright by spraying beneath our California sun. To illustrate these principles, let us take a few other examples, to show that if a plant spends its vital force searching for requisite food or moisture; or, if the law of supply be reversed, efforts balked, or attained at too great an expenditure, little or nothing else can be accomplished. *Abronia arenaria*, as the specific name indicates, grows in sand. If found on deep sand-drifts of the bay shore of San Francisco, or inland, it shoots down a stout fusiform

root of indefinite length ; but often poor and puny is the top, that creeps not far from the crown, with perhaps few flowers and little fruit. But mulch a moist, black, brackish, cracky soil, with only six or eight inches of sand, and it will go down to, or a little into it, spreading abroad its forked subdivisions and fibres, almost or quite horizontally ; the crown-sprouts now run riotously, mantling the sand with vines, full of pink flowers in fruitful umbels unnumbered. Often one spray of water *above* will kill it entirely ; or, the root remaining, it will sometimes come up and flourish again if surface irrigation is neglected, even *two years* afterwards. A similar short horizontal spread of root is seen with *Alfalfa*, on tule or lands fairly shaking and rocking with a peaty carpet ; and so of a thousand roots, otherwise exceedingly deep, and prone to delve. The legitimate practical inferences we leave to the good sense of every enlightened stock-raiser, farmer and cultivator.

Florists are apt to complain that many of our bulbs ere they bloom lose one essential beauty of plants, namely, their *radicle leaves*, which, they say, “dry up, and leave the stems looking naked and bare. They are frequently found upon exposed hills and slopes, rocks, etc., descending down dry and very hot valleys, into debris and alluvial bottoms, where sand or loam with *under-ground moisture* abounds. The very same plants are seen to rejoice best where they find some shade and shelter ; otherwise, they bespeak a struggle for existence, *i. e.*, their leaves prematurely or naturally dry up early to save exhaustion. In half shades, along high banks and slopes, contiguous to creeks, with adequate subsoil moisture, we see *Cyclobothra alba*, with long and beautiful glaucous leaves, say an inch and a half wide and eighteen inches to two feet in length, accompanying the flowers, ten to twenty in number ; the golden *C. pulchella* and most others tolerate more sun and drought, with their companions the manzanita (*Arctostaphylos glauca*), oaks, etc., near whose shades it is wont to linger ; but its best forms love rich, rocky, half shady drains — leaf and flower companions to the close. Witness *Seubertia laxa*, two to four feet high ; the same *Dichelostemas* and *Brodiaeas*, with ten to fifty flowers, and green leaves in similar grace and completeness of beauty. The list might be extended beyond the reader's patience ; what we desire to say and impress is, that the same plants exposed are barely one quarter as large, and with no green leaves at all, or at best a poor apology for them ; and so of numberless others.

Erudite and complex recipes relative to proper mixtures of soils, and common management may well be left to the knowledge and judgment of those who believe in them. With such a wealth of sunlight and heat above as falls to the lot of California, and no lack of the commercial medium, moisture, below, I see no reason why we may not allow Nature, under human hands, to grow her fragrant white Lady Washington lily six or seven feet high, with ten to thirty or more flowers, just as we see it wild. *L. Bloomerianum*, too, is a perfect giant among lilies, when at its best — a right super-royal display — the Divine Teacher himself being judge. Nor why *L. superbum* in a southern bog should be eight feet high, with the best part of a hundred flowers, as we have seen it there, and still the marvellous beauty is ever new as we retrospect. Even our *little* orange *L. parvum*, I found at the Sierra summit over five feet high and fifty flowers — *carefully counted* — but the plant was sheltered and shaded by an old emigrant water-tank stilted up, now dry and long ago abandoned, but its roots found a fair supply of *water from beneath*. — DR. A. KELLOGG, in the *California Horticulturist*.

ON DROUGHT IN ITS RELATION TO WINTER-KILLED TREES.—I was pleased to note how near Prof. Shaler, by a single season's observation (see Vol. vi, p. 671), came to a correct theory of arborescent destruction in winter, which it took me some years to discover after a comparison of numerous facts, — namely, that trees commonly hardy, when they are killed in winter, are destroyed by evaporation, in the same way that they are by drought in a dry summer.

In my younger horticultural days, if any one had given thought at all to the process of destruction, it was to believe that frost expanded the sap in the cells which consequently became ruptured, just as frozen liquid splits a bottle. It fell to my lot to combat this view, and to show that it was evaporation and not expansion. I need not here detail the facts on which this law has been founded. The readers of the "Gardener's Monthly" are familiar with them, and a reference to the Index of the past twelve volumes will readily direct others who have been outside of the horticultural pale, for it is essentially a field for the observing horticulturist to cultivate.

Prof. Shaler was quite right in doubting whether it was the intensity of the cold alone which destroyed the trees, but he is not

quite in accordance with the fact in his suggestion that it was after the frost left the roots that the injury began. If Prof. Shaler will remember that there is an enormous evaporation going on from plants exposed to a dry atmosphere, and that this takes place whether there be frozen soil about the roots or not, he will I think understand how a plant may become exhausted of itself, without waiting for the thaw. If there be a very dry atmosphere, and the roots nearly all encased in frost at the same time, it is still more difficult to supply this waste. The deeper the frost the greater the difficulty, and the more evaporating surface, as in evergreens, the greater the risk.

The destruction by drought and not by the absolute degree of frost being conceded, there remains nothing but to apply the law to general science as Prof. Shaler suggests; a dry atmosphere becomes a destructive agent as well as frost, and those plants which part with their moisture the most readily, as a climate passes from moist to dry, must be the first to disappear. In my grounds I had large quantities of American hornbeam side by side with the English species. These last were all killed to the ground,—the others uninjured. This shows that the American species can resist evaporation better than the European. It is difficult to decide from an evolutionary point of view which of these two very closely allied species had the priority of origin. If we accept the proposition that in water was the beginning of plant life, we might infer that development has been in the direction of the dry atmosphere; and thus arrive at the conclusion that by natural selection the American is an offshoot from the European. In my grounds also the *Liriodendron* suffered terribly. I had ten thousand from one to five feet high killed to the ground, but all above this were uninjured, as their roots were deep in the ground, and could supply the waste of sap without much destruction from the frost. But the fact of the younger ones drying up so easily, shows that this tree was not created for a dry winter climate. We must infer that they are either immigrants, or that the climate has changed since their first appearance. And then again arises another suggestion. Suppose the future seasons should regularly repeat the last, would “natural selection” be sufficient to produce some less liable to loss by evaporation, as we have supposed may have been the case with the hornbeam? Would this change to a greater winter aridity, if continuous, give rise to a new species of *Liriodendron*?

These are some of the thoughts suggested by Prof. Shaler's paper. They are mere "speculations" it is true, but the imagination, under proper control, is a great aid to investigation. If we suspect something we may be led to look for the evidence; and thus learn long before those who wait to stumble on the truth.—
T. MEEHAN.

INFLUENCE OF FOREIGN POLLEN ON THE PARENT PLANT:—Professor Gray adds (Amer. Journ. Science and Arts, Dec., 1872) another to the already numerous instances, says the "Academy," which have placed this mysterious phenomenon beyond dispute. An apple (Spitzbergen) produced a fruit half of which was (at least as to the surface) Spitzenberg, the other half russet. A tree of the latter fruit stood about two hundred yards off. The division into two exactly equal parts is quite unexpected; as the styles and carpels were five, we should have expected the division to be into fifths. Moreover, the action of the pollen in this case is, morphologically, on the calyx, not on the pericarp.

We have been told on excellent authority that apples have been raised in Hopkinton, Mass., which were half sweet and half sour, the line of demarcation being very distinct, so that the distinction in this case was more than skin deep.

[The apple in question was received from the Smithsonian Institution, with an account of its history, and a statement that one or more similar apples had been already received at the Agricultural Department, Washington, and preserved in wax models. Although the external line of demarcation was perfectly distinct, we are bound to add that, on cutting it up and distributing portions among the members of our botanical class, about half the tasters pronounced the morsels to be russet which were taken from the Spitzenberg side of the apple, or *vice versa*. But the fruit was hardly ripe enough.—A. G.]

ZOOLOGY.

A NEW SPECIES OF SPARROW.—Ornithologists will be interested to learn of the recent discovery of a sparrow belonging to the genus *Centronyx*, a genus heretofore represented in collections only by the unique type of *C. Bairdii* collected in 1843 by Audubon. The sparrow in question has been minutely examined and compared with the above mentioned type of *C. Bairdii* by Mr. Robert